

REMARKS

Amendments to the Specification

Applicants have hereby amended the specification, by adding a section for "Cross-Reference to Related Application" and by amending the title of the present application consistent with the Examiner's suggestion on page 2, last paragraph of the August 25, 2005 Office Action.

Response to the Objection to the Specification

In response to the Examiner's objection to the use of the term "phosphorus" on page 1, line 12 of the instant specification, Applicants hereby direct the Examiner's attention to the dictionary definition of the word "phosphorus" provided by the American Heritage Dictionary of the English Language, Fourth Edition (2000), a copy of which is enclosed herewith for the Examiner's reference. Specifically, the word "phosphorus" is a noun that defines the nonmetallic element P, and it is used as a noun in the phrase "phosphorus doping" on page 1, line 12 of the instant specification.¹

Therefore, the word "phosphorus" is correctly spelled and used on page 1, line 12 of the instant specification, and Applicants correspondingly request the Examiner to withdraw the objection to the instant specification.

Response to Claim Objections

In the August 25, 2005 Office Action, the Examiner objected to claims 1, 6, 22, 25, and 27 for using the word "phosphorus."

¹ In the similar manner that the word "boron" is used as a noun in the phrase "boron doping."

Applicants traverse the Examiner's claim rejections, on the basis that the word "phosphorus" refers to the nonmetallic element P, and it is correctly spelled and used in claims 1, 6, 22, 25, and 27. Therefore, it is respectfully requested that the Examiner withdraw the objections to these claims.

In response to the Examiner's objections to claims 4, 6, and 22 for certain self-evident grammatical and typographic errors, Applicants have hereby amended claims 4, 6, and 22 to correct such errors, consistent with the Examiner's suggestions in the August 25, 2005 Office Action.

Response to the §112 Rejection

Applicants' amendments of claims 1, 22, 25, and 27 by deleting the phrase "critical thickness" herein renders the §112 rejection moot.

Response to the §103 Rejection

In the August 25, 2005 Office Action, the Examiner rejected claims 1-6 and 22-26 under 35 U.S.C. §103(a) as alleged obvious over U.S. Patent No. 5,241,197 to Murakami et al. (hereinafter "Murakami") in view of U.S. Patent No. 5,316,958 to Meyerson (hereinafter "Meyerson").

In response, Applicants have hereby cancelled claims 3, 23, 26 and amended claims 1, 22, and 25. Specifically, claim 1, from which claims 2 and 4-6 depend, has been amended to positively recite a first epitaxial layer of Ge "having a thickness in the range from about 0.5 nm to about 2 nm" and "a concentration of dopant greater than 5×10^{19} atoms/cc." The amended claims 22 (from which claim 24 depend) and 25 have been amended to correspondingly recite "a first layer of Ge less than from about 0.5 nm to about 2 nm in

thickness and doped with a dopant selected from the group consisting of phosphorus and arsenic at a dopant concentration of greater than 5×10^{19} atoms/cc." Support for such claim amendments can be found in the instant specification at the paragraph bridging pages 3 and 4, which describes a first epitaxial layer of substantially Ge having a thickness in the range from 0.5 to 2 nm and doped with phosphorus or arsenic to a level of about 5×10^{19} atoms/cc.

The primary reference Murakami only discloses germanium layers that has a thickness of 20 nm or less and an impurity concentration ranging from about 10^{15} to 10^{19} cm⁻³ (see Murakami, column 4, lines 13-15; column 9, lines 48-51, disclosing a p-germanium base layer 221 with a boron concentration of 1×10^{19} cm⁻³; column 12, lines 18-20, disclosing a germanium layer 22 that is 20 nm thick and is doped with boron at a concentration of about 1×10^{18} cm⁻³; and column 12, lines 33-35, disclosing a germanium layer 22 doped with an n-type impurity at a concentration of about 1×10^{18} cm⁻³).

Nothing in Murakami teaches or suggests modification of the disclosed germanium layers, by either reducing their thicknesses to the range from 0.5 nm to 2 nm or increasing their dopant concentrations to greater than 5×10^{19} atoms/cc, as positively recited by claims 1-2, 4-6, 22, 24, and 25 of the present application.

In the August 25, 2005 Office Action, the Examiner expressly conceded the deficiency of Murakami, but attempted to remedy such a deficiency by citing Meyerson and asserting that it would have been obvious to use either phosphorus or arsenic dopant based on a desired concentration disclosed by Meyerson to form n-type regions in the epitaxial layers disclosed by Murakami.

Applicants respectfully disagree with the Examiner's assertion.

Meyerson discloses formation of SiGe layers with high dopant concentrations ranging from about 1×10^{14} atoms/cm³ to about 1×10^{20} atoms/cm³, wherein the doping level is determined based on the desired device characteristics (see Meyerson, column 5, lines 17-20).

Nothing in Meyerson teaches or suggests that the SiGe layers so formed can have a thickness in the range of about 0.5-2 nm, as positively recited by claims 1-2, 4-6, 22, 24, and 25 of the present application. On the contrary, Figure 2 of Meyerson shows in part B a SiGe layer having a thickness of about 200 nm, which is more than 100 times thicker than the 2 nm upper limit of the thickness range recited by claims 1-2, 4-6, 22, 24, and 25 of the present application.

In the August 25, 2005 Office Action, the Examiner attempted to bridge the gap between the Meyerson reference and Applicants' claimed invent, by asserting that "[the] selection of parameters such as energy, power, concentration, temperature, time, depth, thickness, etc., would have been obvious and involve routine optimization which has been held to be within the level of ordinary skill in the art" and citing *In re Aller*, 105 USPQ 233, 235 (CCPA 1955).

The Federal Circuit Court has held in a more recent case that "our precedents do not establish any *per se* rule of obviousness," that "reliance on *per se* rules of obviousness is legally incorrect and **must** cease." *In re Ochiai*, 37 USPQ2d 1127, 1133 (Fed. Cir. 1995).

Therefore, it is impermissible for the Examiner in the present case to avoid the trouble of conducting fact-specific analysis of the claims in issue and the prior art, by simply relying on the *per se* rule of obviousness in establishing that selection of parameters, such as energy, power, concentration, temperature, time, depth, thickness, etc., is *per se* obvious.

The instant specification discusses the Meyerson reference on its background section on page 2. Specifically, the instant specification recognizes that by adding Ge in the reaction

zone of a UHV-CVD reactor, the incorporation of phosphorus dopant into a Si layer can be increased, as taught by Meyerson. However, the instant specification then points out the deleterious "memory effect" of the *in-situ* phosphorus doping techniques disclosed by Meyerson, which result s in undesirable "smearing out" of the dopant profile in the silicon films, and states on page 3, second full paragraph that very thin layer structures having high doping concentrations cannot be achieved by present technology at this point using present ultra high vacuum-chemical vapor deposition (UHV-CVD) or standard silicon CVD processing.

Therefore, it is clear that the conventional UHV-CVD processing techniques disclosed by the Meyerson reference cannot be used to form very thin Ge layer of high dopant concentration, which is an inherent limitation of the Meyerson reference that cannot be overcome by "routine experimentation," despite the assertion of the Examiner.

Correspondingly, claims 1-2, 4-6, 22, 24, and 25 of the present application patentably distinguish over the combination of Murakami and Meyerson, by reciting a Ge layer having a thickness ranging from about 0.5 nm to about 2 nm and doped with a dopant selected from the group consisting of phosphorus and arsenic at a dopant concentration of greater than 5×10^{19} atoms/cc.

Applicants respectfully request the Examiner to reconsider, and upon reconsideration to withdraw, the rejections of claims 1-2, 4-6, 22, 24, and 25.

Allowable Claims 27 and 28

In the August 25, 2005 Office Action, the Examiner indicated that claims 27 and 28 would be allowable if amended to overcome the objection and rejection under 35 U.S.C. 112.

In response, Applicants have cancelled claim 28 and incorporated the thickness limitation of claim 28 into claim 27, so that the phrase "critical thickness" can be deleted from claim 27.

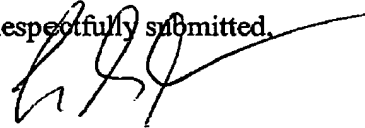
Further, with respect to the objected word "phosphorus," Applicants have shown hereinabove that this word is spelled and used properly.

CONCLUSION

Based on the foregoing, claims 1-2, 4-6, 22, 24, 25, and 27 of the present application are in condition for allowance. Issue of a Notice of Allowance for the application is therefore requested.

If any issues remain outstanding, incident to the formal allowance of the application, the Examiner is requested to contact the undersigned attorney at (516) 742-4343 to discuss same, in order that this application may be allowed and passed to issue at an early date.

Respectfully submitted,



Leslie S. Szivos
Registration No. 39,394

SCULLY, SCOTT, MURPHY & PRESSER
400 Garden City Plaza, Suite 300
Garden City, New York 11530
(516) 742-4343

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The American Heritage® Dictionary of the English Language: Fourth Edition. 2000.

phosphorus

SYLLABICATION: phos·pho·rus

PRONUNCIATION: fōs'fər-əs

NOUN: 1. *Symbol P* A highly reactive, poisonous, nonmetallic element occurring naturally in phosphates, especially apatite, and existing in three allotropic forms, white (or sometimes yellow), red, and black. An essential constituent of protoplasm, it is used in safety matches, pyrotechnics, incendiary shells, and fertilizers and to protect metal surfaces from corrosion. Atomic number 15; atomic weight 30.9738; melting point (white) 44.1°C; boiling point 280°C; specific gravity (white) 1.82; valence 3, 5. See table at [element](#). 2. A phosphorescent substance.

ETYMOLOGY: Latin *Phōsphorus*, morning star, from Greek *phōsphoros*, bringing light, morning star : *phōs*, light; see [bhā-](#)¹ in Appendix I + *-phoros*, -phorous.

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